Research

Research Project: PARTICULATE EMISSIONS FROM WIND EROSION: PROCESSES, ASSESSMENT, AND CONTROL

Location:

Title: Fine Particulates (Pm10 and PM2.5) Generated by Breakage of Mobile Aggregates During Simulated Wind Erosion

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Interpretive Summary: Wind erosion of soils generates fine particulates by three major processes " entrainment (emission) of loose, mobile aggregates from the surface, abrasion from immobile clods/crusts, and breakage of mobile saltation/creep aggregates. Some of the generated particulates are less than 10 microns diameter (PM10) or less than 2.5 microns (PM2.5) and are regulated as health hazards. To improve prediction of PM10 generation in erosion models, parameters must be established for these processes. The objectives of this research were to measure relative breakage rated of saltation-size aggregates to suspension-size and determine the fractions of PM10 and PM2.5. Soil samples were collected from 9 states (AZ, CA, NV, CO, KS, NE, NM, OK, and TX). The breakage process was simulated by repeated impacts of saltation-size aggregates in an enclosed chamber. For soils with large clay or saltation-size sand fractions, breakage rates were about one-third that of other soils. On average, 5 percent of the suspension-size soil created by breakage was PM10 and 15 percent of the PM10 was PM2.5. These results demonstrate that the suspension-size particles created by the breakage process have higher proportions of PM10 and PM2.5 than the suspension-size soil generated from the emission and abrasion processes.

Technical Abstract: Wind erosion of soils generates fine particulates that are health hazards (PM10 and PM2.5) by three major processes " entrainment (emission) of loose, mobile aggregates from the surface, abrasion from immobile

clods/crusts, and breakage of mobile saltation/creep aggregates. To improve prediction of PM10 generation in erosion models, parameters must be established for these processes. The objectives of this research were to measure relative breakage rated of saltation-size aggregates to suspension-size and the fractions of PM10 and PM2.5 generated by the breakage process for a range of soils. Soil samples were collected from 9 states (AZ, CA, NV, CO, KS, NE, NM, OK, and TX). Sub-samples of the soils were used to determine organic matter and calcium carbonate fractions. Other sub-samples were dispersed to determine sand, silt, and clay fractions. The breakage process was simulated in the laboratory by repeated impacts of saltation-size aggregates in an enclosed chamber. Relative breakage rates averaged 0.044 for aggregates with saltation-size sand/clay ratios between 0.1 and 10. Rates for aggregates with either large clay or saltation-size sand fractions were significantly less, averaging 0.015. The fraction of PM10 in the suspension component created by breakage (SF10bk) averages 0.049 over all soils. The SF10bk was inversely proportional to both clay content and annual precipitation. Average SF10bk was 0.069 with clay fraction <0.1, but significantly lover, 0.030, with clay fraction>0.1. The average ratio of PM2.5/PM10 was 0.154, but increased with saltation-size sand/clay ratio and decreased with precipitation. The predicted values ranged from about 0.1 to 0.3 (R2 = 0.53).

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